The Commonwealth of Massachusetts Executive Office of Health and Human Services
Department of Public Health

Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) Massachusetts 2003

Division of Research and Epidemiology
Bureau of Health Statistics, Research and Evaluation
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Background

The Division of Research and Epidemiology in the Bureau of Health Statistics, Research and Evaluation in the Department of Public Health used Centers for Disease Control and Prevention's Smoking-Attributable Mortality, Morbidity, and Economic Costs (SAMMEC) application to examine the impact of smoking on Massachusetts residents in 2003. SAMMEC includes an Adult and a Maternal and Child Health (MCH) program that provide the ability to estimate the health and health-related economic consequences of smoking (CDC, SAMMEC, 2006).

SAMMEC calculates annual state and national-level smoking-attributable deaths and years of potential life lost for adults and infants in the United States. The Adult application also calculates medical expenditures and productivity costs among adults. Likewise, Maternal and Child Health (MCH) SAMMEC estimates annual state and national-level smoking-attributable deaths and years of potential life lost for infants (CDC, SAMMEC, 2006).

Major Findings

The 2003 Massachusetts SAMMEC data indicate significant smoking-related loss of life and economic costs despite the recent decline in smoking rates. Much of the smoking-related mortality and economic costs occurring in 2003 are the result of higher smoking prevalence in the past. The 2003 BRFSS data indicate that an average of 19.1% of Massachusetts adults are current smokers. The findings for 2003 may, in fact, underestimate the true impact of cigarette smoking because the SAMMEC application uses the current lower smoking rates in its calculations.

Analyses of SAMMEC data for 2003 indicate that there were 9,040 total deaths attributable to smoking. Overall, approximately 25 Massachusetts residents die each day from smoking-related causes. In terms of economic impact, smoking costs approximately $1.9 billion in lost productivity due to premature deaths of smokers. Additionally, in 2003 smoking costs were estimated at $3.6 billion in personal health care expenditures.

The 9,040 smoking-attributable deaths among residents age 35 and over can be classified by four major categories: cancer, heart disease, and respiratory disease. Table 1 presents the smoking-attributable deaths associated with each disease. Fire deaths are from the fact sheet, "Massachusetts Fires in 2003," Department of Fire Services Office of the State Fire Marshal. These data do not include any deaths from environmental exposure to tobacco smoke; the SAMMEC program does not calculate deaths or disease from second-hand smoke. Also, these data do not include deaths attributable to pipe, cigar, or smokeless tobacco use. The 9,040 deaths represent 16.5% of all deaths of residents age 35 and over; 19.6% of male deaths, and 13.7% of female deaths.

According to SAMMEC data, seven Massachusetts infants died in 2003 from causes associated with maternal smoking. For 2003, the cause of death include short gestation/low birth weight (Figure 2).

Table 1. Smoking-Attributable Mortality – 2003

Cause of Death	Males	Females	Total
Malignant Neoplasms			
Lip, Oral Cavity, Pharynx	76	30	106
Esophagus	227	51	278
Stomach	44	19	63
Pancreas	77	103	180
Larynx	53	16	69
Trachea, Lung, Bronchus	1,658	1,310	2,968
Cervix Uteri	0	4	4
Urinary Bladder	111	35	146
Kidney and Renal Pelvis	63	4	67
Acute Myeloid Leukemia	26	11	37
Total Malignant Neoplasms	**2,335**	**1,583**	**3,918**
Cardiovascular Diseases			
Ischemic Heart Disease	893	627	1,520
Other Heart Disease	335	265	600
Cerebrovascular Disease	127	151	278
Atherosclerosis	21	9	30
Aortic Aneurysm	117	76	193
Other Arterial Disease	9	20	29
Total Cardiovascular Diseases	**1,502**	**1,148**	**2,650**
Respiratory Diseases			
Pneumonia, Influenza	186	149	335
Bronchitis, Emphysema	128	169	297
Chronic Airways Obstruction	823	996	1,819
Total Respiratory Diseases	**1,137**	**1,314**	**2,451**
Fire Deaths*			
Smoking-caused fire deaths	**13**	**8**	**21**
All Cause Total	**4,987**	**4,053**	**9,040**

Smoking Prevalence	MDPH 2003 MA BRFSS
Relative Risk	CPS-II (82-88)
Mortality	MDPH 2003 MA Mortality

In 2003, Massachusetts' residents lost a total of 118,084 years of potential life lost due to smoking-related disease (Table 2). This figure represents, on average, a loss of almost 13 years of life for every smoker in the state. Table 2 shows a list of the smoking-attributable years of potential life lost associated with each disease. These figures do not include the 539 years of potential life lost due to infant mortality related to maternal smoking presented in Figure 2.

Table 2. Smoking-Attributable Years of Potential Life Lost (YPLL) by Disease, Massachusetts 2003

Cause of Death	Males	Females	Total
Malignant Neoplasms			
Lip, Oral Cavity, Pharynx	1,234	494	1,728
Esophagus	3,235	720	3,955
Stomach	616	237	853
Pancreas	1,141	1,591	2,732
Larynx	818	233	1,051
Trachea, Lung, Bronchus	23,535	20,888	44,423
Cervix Uteri	0	101	101
Urinary Bladder	1,196	449	1,645
Kidney and Renal Pelvis	890	52	942
Acute Myeloid Leukemia	359	166	525
Total Malignant Neoplasms	**33,024**	**24,931**	**57,955**
Cardiovascular Diseases			
Ischemic Heart Disease	13,103	7,399	20,502
Other Heart Disease	3,919	2,801	6,720
Cerebrovascular Disease	1,823	2,241	4,064
Atherosclerosis	195	69	264
Aortic Aneurysm	1,280	805	2,085
Other Arterial Disease	103	192	295
Total Cardiovascular Diseases	**20,423**	**13,507**	**33,930**
Respiratory Diseases			
Pneumonia, Influenza	1,605	1,396	3,001
Bronchitis, Emphysema	1,513	2,107	3,620
Chronic Airways Obstruction	8,272	11,306	19,578
Total Respiratory Diseases	**11,390**	**14,809**	**26,199**
All Cause Total	**64,837**	**53,247**	**118,084**
Smoking Prevalence	MDPH 2003 MA BRFSS		
Mortality	MDPH 2003 MA Mortality		
Relative Risk	CPS-II(82-88)		
Life Expectancy*	US 2001 Life Expectancy		

* Note that , since US life tables are used to calculate YPLL, the MA YPLL may be UNDERESTIMATED because MA, in general, had a longer life expectancy that the US for 5-year age groups.

Smoking-attributable lost productivity costs were calculated to be over $1.9 billion dollars in 2003 (Figure 3). A total of $1,063 million dollars was lost to premature death from smoking-related cancers. An additional $571 million dollars were due to premature deaths from smoking-

attributable heart disease, and $301 million dollars per year were lost due to premature deaths from smoking-related respiratory diseases. However, these figures do not include any lost productivity costs from deaths related to exposure to second-hand smoke.

Smoking-attributable health care expenditures are the excess personal health care costs of smokers and former smokers. For those residents over 18 years of age, $3.642 billion dollars were spent on smoking-related illnesses in 2003 in Massachusetts (Figure 4). This figure represents 10% of all health care expenditures in the Commonwealth. There were an additional $7.3 million dollars of smoking-attributable neonatal expenditures in Massachusetts in 1999 as estimated by the SAMMEC program. This figure represents 2% of all neonatal expenditures in the Commonwealth.

Data Collection and Analyses

Data on smoking prevalence are from the 2003 Massachusetts Behavioral Risk Factor Surveillance System (BRFSS). For each year since 1986, the Commonwealth of Massachusetts has collected data on smoking through the BRFSS. This system includes a random-digit-dialed telephone survey of non-institutionalized adults years 18 or older. BRFSS is a cooperative effort between the Centers for Disease Control and Prevention (CDC) and state health departments. In 2002, 7,580 adults completed interviews conducted through the Massachusetts BRFSS. Data on maternal smoking prevalence were obtained from certificates of live birth from Massachusetts Registry of Vital Records and Statistics for mothers who gave birth in Massachusetts in 2003.

Data on outcomes were provided from several sources. The American Cancer Society's Cancer Prevention Study provided estimates of the relative risks of mortality for smoking related diseases. Massachusetts mortality data were obtained from death certificates from the Registry of Vital Records and Statistics for the year 2003. Smoking prevalence data and relative risk estimates were used to calculate the smoking-attributable fraction (SAF) for each smoking related disease for adult current and former smokers aged 35 years and older. The SAFs were then combined with Massachusetts mortality data to estimate the number of deaths attributable to smoking.

Smoking-attributable years of potential life lost (YPLL) is defined as the sum of the years of life lost from premature deaths caused by smoking. This figure was obtained by multiplying the midpoint estimate of remaining life expectancy (RLE), which was obtained from 2001 National Centers for Health Statistics life tables, for each smoking-related disease, sex, and five-year age by the number of smoking-attributable deaths. Since Massachusetts, in general, had a longer life expectancy than US estimates, the life expectancy data from the 2001 US Life Expectancy tables may underestimate YPLL for Massachusetts residents. Table A. Expectation of Life by Age, Race, and Sex: United States, 2003, in 2003 National Centers for Health Statistics life tables was used for figure 2.

Smoking-attributable productivity costs are calculated as the estimated costs of lost future earnings from paid market and unpaid household labor resulting from premature death due to smoking-related disease. This measure is considered to be an economic parallel to YPLL and is based on the present value of future earnings with an annual 1% increase in labor productivity. SAMMEC uses updated age-specific present value of lifetime future earnings estimates from "Prevention Effectiveness: A Guide to Decision Analysis and Economic Evaluation" by A.C.

Haddix et al. 1996. These cost data were combined with smoking-attributable mortality estimates of the year 2003 in Massachusetts to calculate total smoking-attributable productivity costs.

Smoking-attributable health care expenditures are defined as the excess personal health care costs of smokers and former smokers compared to those residents who have never smoked. Figures are obtained by applying the smoking-attributable fraction (SAF) to total health care expenditures for the state of Massachusetts. The SAF of medical expenditures reflects the proportion of annual personal health care expenditures that could be avoided if smoking were eliminated from the population. SAMMEC uses expenditures that could be avoided if smoking were eliminated from the population. SAMMEC uses expenditures SAFs from B.P. Miller et al. "Smoking Attributable Medical Care Costs in the United States" Social Science and Medicine, 1999. The health care expenditure data are for 1998 for the state of Massachusetts as published on CDC's SAMMEC website: http://apps.nccd.cdc.gov/sammec/show_same_data.asp.

The smoking-attributable fraction (SAF) is a critical calculation for the SAMMEC application. The SAF is used to calculate Smoking-Attributable Mortality (SAM) for 19 smoking-related diseases. The SAF is calculated using sex-specific smoking prevalence and relative risk (RR) of death data for adult current and former smokers age 35 and over. Infant mortality SAFs are calculated using maternal smoking prevalence and RR of death estimates for four perinatal conditions caused by smoking. The SAFs for each disease and sex are derived using the following formula:

$$SAF=[(p0 + p1(RR1) + p2(RR2))-1]/[p0 + p1(RR1) + p2(RR2)]$$

Where p0 is the percentage of adult never smokers in the study group (in this case, Massachusetts residents), or with the maternal and child health calculations, the percentage of maternal nonsmokers in the study group.

p1 is the percentage of adult current smokers in the study group, or with the maternal child health calculations, the percentage of maternal smokers in the study

p2 is the percentage of adult former smokers in the study group. This figure does not apply to maternal child health calculations.

RR1 is the relative risk of death for adult current smokers relative to adult never smokers, or with the maternal and child health calculations, the relative risk of death for infants of maternal smokers relative to infants of maternal nonsmokers.

RR2 is the relative risk of death for adult former smokers relative to adult never smokers. This figure does not apply to maternal child health calculations.

Relative Risk estimates for persons 35 and older were obtained from the second wave of the American Cancer Society's Cancer Prevention Study (CPS-II), and six-year follow-up (Thun et al. 1997. ACS published). Relative risk estimates for short-gestation/low birth weight, Sudden Infant Death Syndrome (SIDS), Respiratory Distress Syndrome (RDS) and other infant conditions

were obtained from a meta-analysis of the epidemiological literature conducted by Gavin et al. (2001).

All relative risk data are pre-set by the SAMMEC computer software package; death data and smoking prevalence data are Massachusetts-specific data and are input into the computer software programs to generate data for the above analyses.

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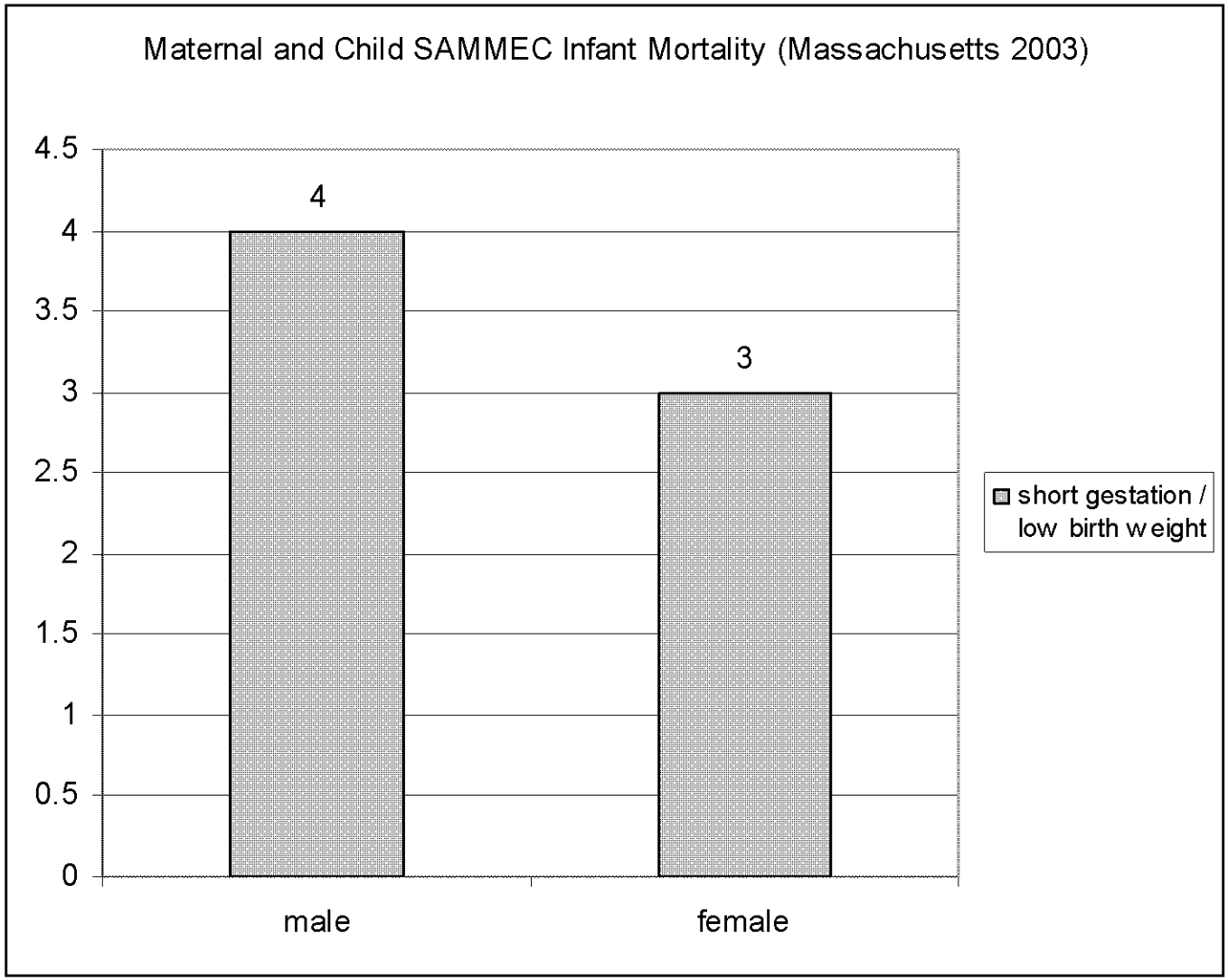
Maternal and Child SAMMEC Infant Mortality (Massachusetts 2003)
4.5
4
3.5
3
2.5
2
1.5
1
0.5
0
4
3
male
female
short gestation / low birth weight

Figure 2. Smoking Attributable Years of Potential Life Lost (YPLL) for Infants Born in Massachusetts 2003

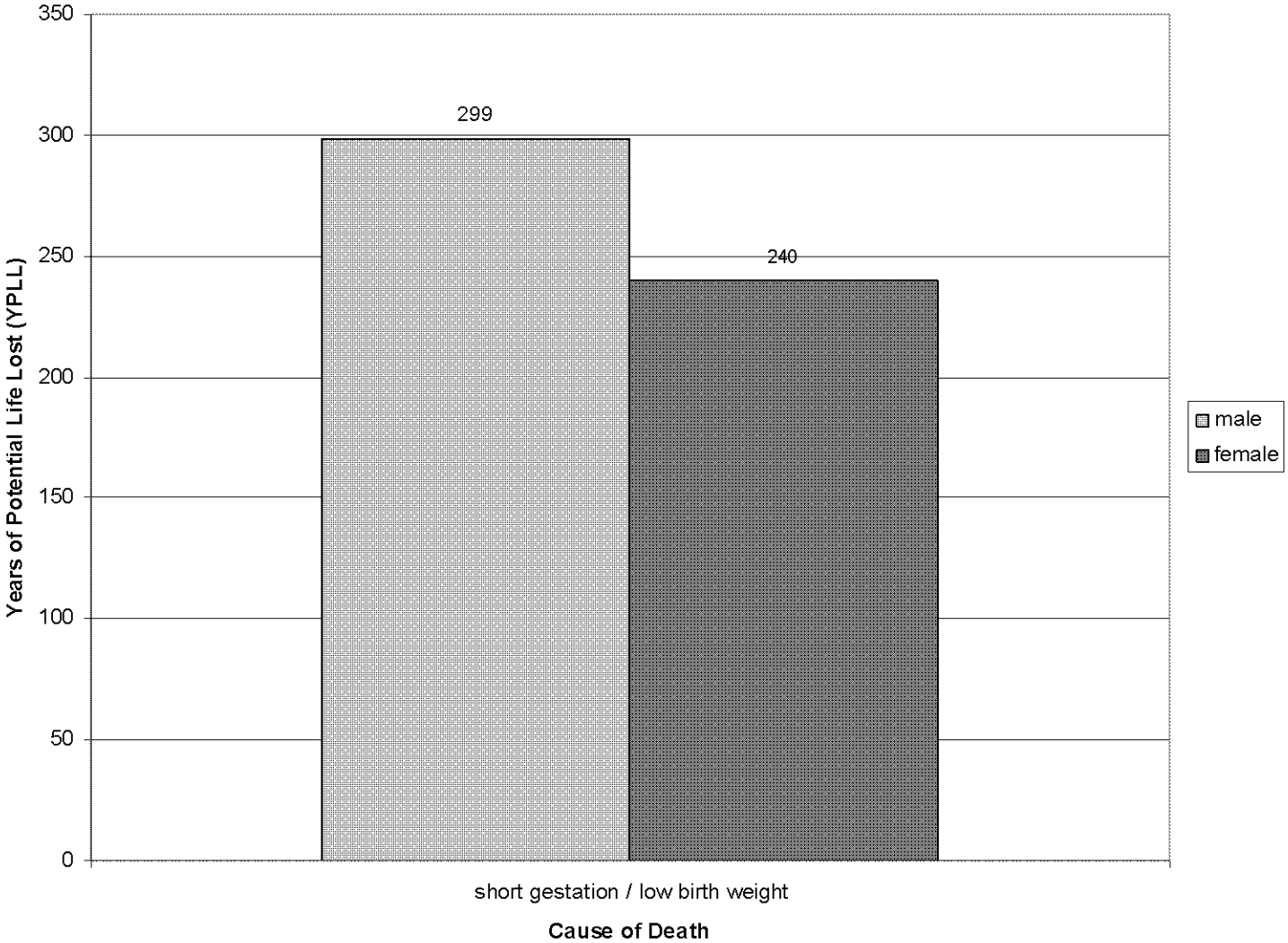

Figure 3. Smoking Attributable Productivity Costs in Millions of Dollars - Massachusetts 2003

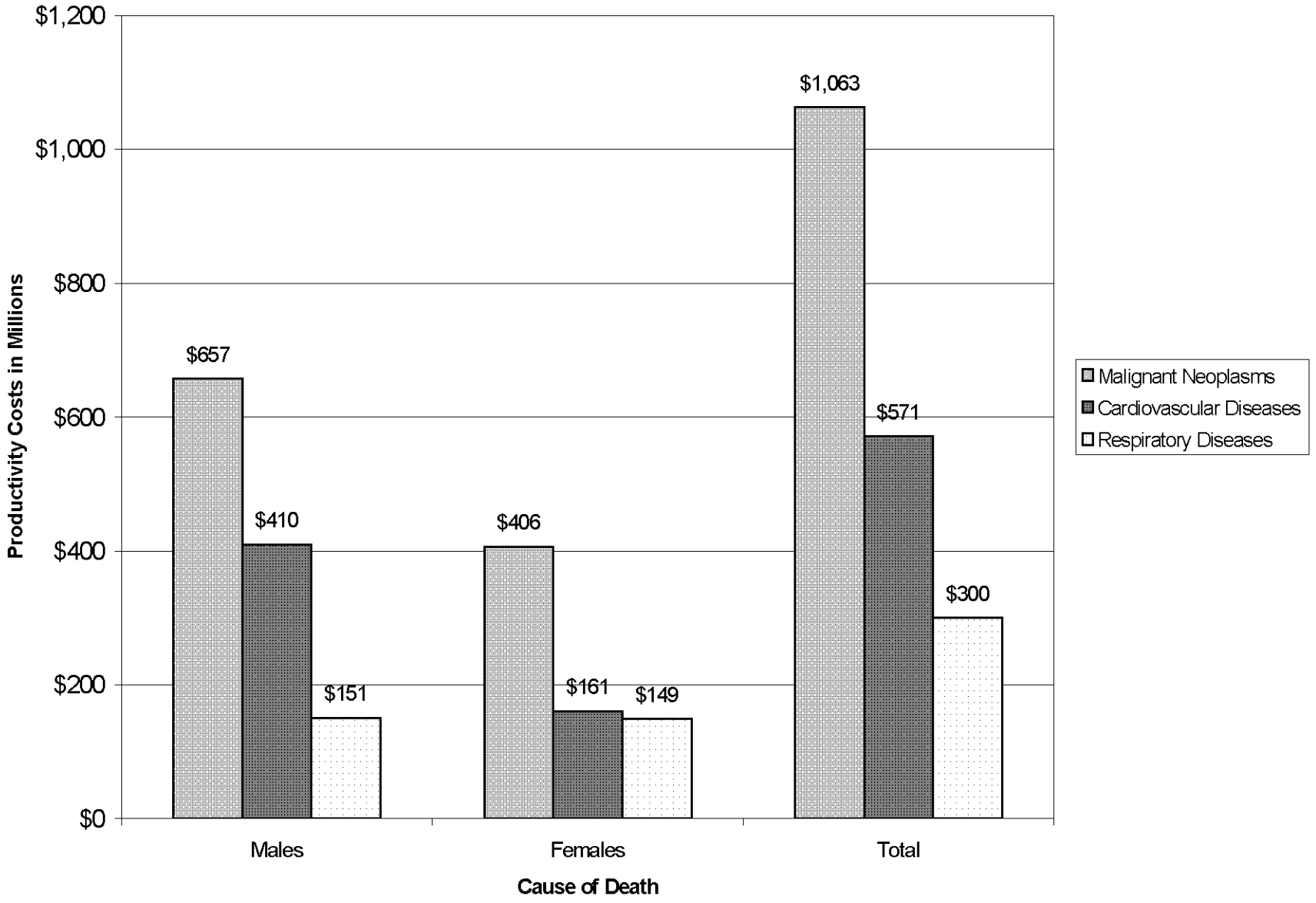

Figure 4. Smoking-Attributable Health Care Expenditures in Millions of Dollars - Massachusetts 2003 (age 18+)